SPAWAR Systems Center San Diego

ROBOTICS UPDATE

"Providing network-integrated robotic solutions for C4ISR applications."

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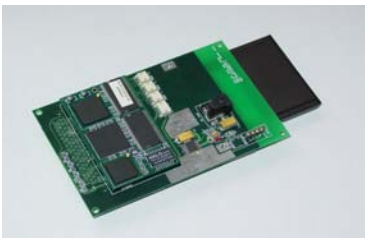
DARPA Project Develops Compact Ad Hoc Networking Radios

Under the Defense Advanced Research Projects Agency (DARPA) Information Process Techniques Office (IPTO) Software for Distributed Robotics Program, SSC San Diego joined with BBN Technologies to develop and implement a new ad hoc networking solution to solve several problems that exist with wireless modems in mobile applications.

Radio interconnect board with Orinoco wireless LAN

Currently, the IEEE 802.11-type wireless modems are difficult to use in a mobile-robot-based network. Most require two units to operate in relay mode (access point and bridge), or are too large. They are also inefficient in network reorganization in the presence of node mobility.

BBN developed networking software that uses a proactive link-state protocol that provides each node in the network complete information about the characteristics of all links. In addition, the software maintains the network links for optimal information transmission and minimal lag, using a distributed routing algorithm that determines the optimal transmission paths. The routing table is recomputed whenever certain network events occur (such as when the link quality between two nodes has dropped below a preset level appropriate for a desired scenario). This allows routes to be changed before a link is broken, automatically maintaining the network in a proactive fashion.



Bottom view of board with nanoEngine processor

This software has been incorporated into a set of compact ad hoc networking wireless modems, each about the size of a deck of playing cards. Each stand-alone modem contains an 802.11b wireless LAN card (the ORiNOCO *WaveLAN* PC Card Gold) and a small single-board computer (the Bright Star Engineering *nanoEngine*).

SSC San Diego developed a radio interconnect board (RIB) to interface the wireless LAN radio to the *nanoEngine*. The RIB also provides regulated power to both units, protected against reverse-voltage and over-voltage conditions, and allows access to the serial and Ethernet ports. An external antenna connection is available to provide extended communication range. The complete radio package consumes no more than 4.5 watts of power.

Chem/Rad Sensor Payload Achieves Army LOE Objective

A Chemical, Biological, Radiological, and Nuclear (CBRN) sensor payload was recently developed by SSC San Diego at the request of the US Army Chemical School (Fort Leonard Wood). As part of the development, a Limited Objective Experiment (LOE) was conducted in February 2003 at SSC San Diego to test the payload within a confined space.

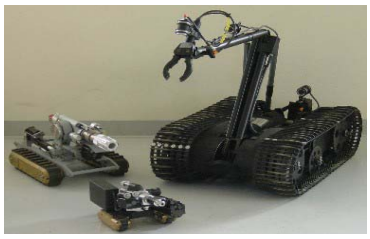
The payload contains three standard-issue sensors from the Army inventory: the MultiRAE Plus gas sensor, the Joint Chemical Agent Detector, and the AN/UDR-13 Radiac. Initially designed for the SSC San Diego URBOT (using Ethernet) as a plug-and-play application payload, the module was subsequently adapted for use on the Mesa Engineering Matilda robot (using RS-232). Both platforms were successfully tested inside Battery Woodward, a WW II-era underground bunker complex.

As a result of their efforts to expedite this development in preparation for Operation Iraqi Freedom, Michael Bruch, Aaron Burmeister, Jason Lum, and Bart Everett were each presented Brigadier General Nilo's "Coins of Excellence" by Chemical Regimental Command Sergeant Major CSM Peter Hiltner.

Another version of this payload package is currently being designed to mate with the iRobot PackBot. Further development of a biological capability will be considered once practical-sized sensors become available.

Small Mobile Robot Pool Receives Initial Assets

The Joint Robotics Program (JRP) Small Mobile Robot Pool (SMRP) was established at SSC San Diego to facilitate exposing the warfighter to "state of the art" technology, while simultaneously generating feedback for the product developer. Prospective users seeking to evaluate a small mobile robot to address a tactical challenge can request a loan from the SMRP to conduct their experiment. Hardware is typically available for up to six months, with extensions approved on a case-by-case basis. Loans are contingent on the user's agreement to provide feedback on the robot's performance, and recommendations for enhancing its capabilities. Equipment and training are provided at no cost, while the user covers shipping expenses.



Included in the SMRP are Inuktun's Mini Disrupter Vehicle (left); Inuktun's Micro Disrupter Vehicle (center); and Foster-Miller's Talon (right)

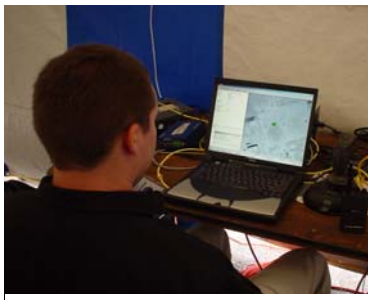
The SMRP has received numerous requests indicating a high demand and serious interest. All requests will be vetted based on the quality of the experiment and its usefulness to DoD missions. However, the policy does not preclude other federal, state, and local agencies from participating.

MDARS-E Showcased in Air Force *Project Leap Ahead* Demos

The Mobile Detection Assessment Response System Exterior (MDARS-E) platform was showcased during Project Leap Ahead demonstrations held in December at Eglin AFB, Florida, along with other advanced security technologies. MDARS is managed by the Office of the Product Manager, Physical Security Equipment (PM-SPE), at Belvoir, VA, with SSC San Diego providing technical direction. The demonstrations were intended to illustrate the Air Force's future vision of integrated security systems.

Those in attendance included Mr. William Davidson, Administrative Assistant to the Secretary of the Air Force, and Brigadier General Shamess, USAF.

Project Leap Ahead was sponsored by the USAF Force Protection C2 Program Office and conducted by TRW. According to the program office, "These transformational security technologies will significantly enhance future security force capabilities and optimize manpower."



SSC San Diego engineer Jeff Muehlhauser with the Multi-robot Operator Control Unit

The MDARS-E platform was part of the "Flightline or Alert Area" scenario, which demonstrated the ability to detect, identify, track, assess, report, and respond to adversary personnel and vehicles, as well as perform positive area access control. In this scenario, an intruder infiltrated an area monitored by unattended ground sensors. Once a suspected penetration was detected, the MDARS-E platform was deployed to intercept the intruder. Attendees were able to monitor the entire scenario on multiple video screens inside a central command tent.

Project Leap Ahead was supported at Florida by SSC San Diego MDARS team members Donny Ciccimaro, Laura Day, Thomas Denewiler, Bart Everett, Gary Gilbreath, Jeff Muehlhauser, and Steve Stancliff.

Upon arrival, the SSC San Diego team set up a control station and communications infrastructure, installed robot paths, and repaired damage to the robot that occurred during shipping. They supported five formal demos over three days as well as numerous practice demos. Additional support was provided by MDARS team members in San Diego, PM-PSE, and General Dynamics Robotics Systems (GDRS).

Suspected "intruder" surrenders to MDARS-E during demo

There were several notable accomplishments for the MDARS program during this evolution. The SSC San Diego MDARS team prepared the vehicle for travel to Eglin on only two weeks' notice, as well as installed the robot and infrastructure once at Eglin within two days. Additionally, this was the first field test of the Multi-robot Operator Control Unit (MOCU), which was recently developed for tactical applications by SSC San Diego software engineers. MOCU was slightly modified for this demo for use with the MDARS-E platform. Using MOCU, the team was able to quickly create robot paths by drawing them on a laptop screen that displayed an overhead image of the demonstration area.

MDARS-E performed consistently and reliably under poor weather conditions, which included several days of rain and near-freezing temperatures.

MDARS-E with 29" iStar UAV on-board

SSC San Diego Acquires Tactical Mobile Robot Program

In February 2003, the Defense Advanced Research Projects Agency (DARPA) transferred four residual contracts from the Tactical Mobile Robot (TMR) Program to SSC San Diego for further administration. These contracts include iRobot, Inc., Foster-Miller, Inc., the Southwest Research Institute, and the University of South Florida.

Along with these contracts, DARPA transferred a significant number of prototype robotic systems that had accumulated over the course of the TMR Program. SSC San Diego is evaluating this collection of hardware and will add those with remaining viability to its Small Mobile Robot Pool (SMRP).

The transfer of the DARPA contracts was accompanied by an increase in funding from the Office of the Secretary of Defense (OSD) Joint Robotics Program (JRP) to enhance the technologies supporting the present generation of tactical mobile robots, enabling SSC San Diego to continue work on these contracts and further pursue the objectives of the TMR Program. Specific work will be directed toward developing a better operator control unit (OCU), easier integration of payloads and platforms, more effective mine-countermeasures capability, and a larger and more varied inventory of robotic platforms to be made available to the user community for operational test and evaluation.

PackBots in EOD configuration (upper right); Explorer configuration (lower right); and Scout configuration with wearable OCU (left)

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